10-1919

Dairy Barn and Milk House Arrangement

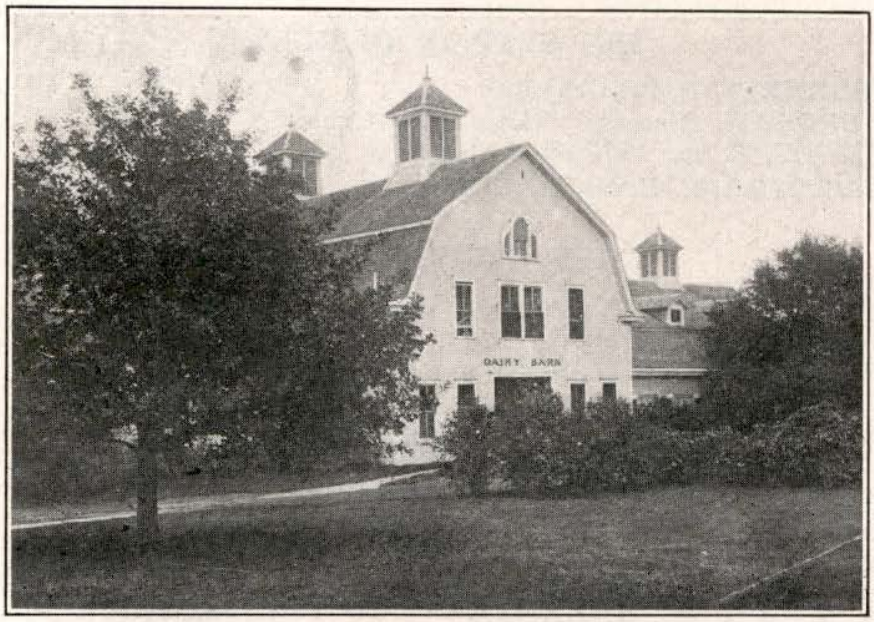
J. H. Frandsen

W. B. Nevens

Circular 6 October, 1919

Dairy Barn and Milk House Arrangement

J. H. FRANDSEN and W. B. NEVENS



DAIRY BARN AT THE UNIVERSITY OF NEBRASKA

AGRICULTURAL EXPERIMENT STATION
THE UNIVERSITY OF NEBRASKA
LINCOLN

THE OFFICIAL ROSTER OF THE STATION

THE GOVERNING BOARD

(THE REGENTS OF THE UNIVERSITY)

HON. EDWARD P. BROWN, *President*, Davey,
Term expires January, 1921
HON. JOHN E. MILLER, *Vice-President*, Lincoln
Term expires January, 1921
HON. PHILIP L. HALL, Lincoln.....Term expires January, 1923
HON. HARRY D. LANDIS, Seward.....Term expires January, 1923
HON. JOHN R. WEBSTER, Omaha.....Term expires January, 1925
HON. FRANK D. JUDSON, Omaha.....Term expires January, 1925

SAMUEL AVERY, Ph. D., LL. D., *Chancellor*
J. S. DALES, M. Ph., *Financial Secretary*

THE STATION OFFICERS

E. A. BURNETT, D. Sc., *Director*
W. H. BROKAW, *Director of Extension Service*
C. A. LEWIS, B. Sc., *Bulletin Editor*
W. W. MARSHALL, *Executive Clerk*

THE WORKING STAFF

L. W. CHASE, M. E., A. E., *Agricultural Engineering*
W. W. BURR, B. Sc., *Agronomy*
T. A. KIESSELBACH, PH. D., *Agronomy*
H. J. GRAMLICH, B. Sc., *Animal Husbandry*
L. VAN ES, M. D., V. S., *Animal Pathology and Hygiene*
F. W. UPSON, PH. D., *Chemistry*
J. H. GAIN, M. D. C., *Animal Pathology and Hygiene*
J. H. FRANDSEN, M. S. A., *Dairy Husbandry*
LAWRENCE BRUNER, B. Sc., *Entomology*
M. H. SWENK, A. M., *Entomology*
R. F. HOWARD, A. M., *Horticulture*
G. A. LOVELAND, A. M., LL. B., *Meteorology*
E. MEAD WILCOX, PH. D., *Plant Pathology and Physiology*
F. E. MUSSEHL, B. Sc., *Poultry Husbandry*
H. C. FILLEY, A. M., *Rural Economics*
W. P. SNYDER, M. S., *Superintendent Experimental Substation*, North Platte
E. M. BROUSE, B. Sc., *Superintendent Experimental Substation*, Valentine
J. A. HOLDEN, B. Sc., *Superintendent Experimental Substation*, Mitchell
J. W. CALVIN, B. Sc., *Assistant in Agricultural Chemistry*
P. L. GADDIS, A. B., B. Sc., *Assistant in Agronomy*
F. D. KEIM, B. Sc., *Assistant in Agronomy*
H. M. MARTIN, V. M. D., *Assistant in Animal Pathology and Hygiene*
J. W. HENDRICKSON, A. M., *Assistant in Dairy Husbandry*
JOHN LUITHLY, B. Sc., *Assistant in Dairy Husbandry*
J. O. RANKIN, A. M., *Assistant in Rural Economics*

DAIRY BARN AND MILK HOUSE ARRANGEMENT

J. H. FRANDSEN AND W. B. NEVENS

The dairy cow, of all farm animals, is our most efficient machine for converting farm grown feeds into concentrated, high-priced food products. She is thin in flesh and naturally more susceptible to cold than most other classes of farm stock. If she is compelled to fortify herself against cold, snow, sleet and rain, she must, of course, convert a greater proportion of her feed into heat with which to keep up body temperature, and as a result she becomes less efficient for milk production.

Therefore, from an economic point of view, as well as from the standpoint of animal comfort, it is highly desirable that adequate barn or shed facilities be provided for the dairy herd.

Thru mistaken ideas of many writers some farmers have developed the idea that to keep cows healthy and comfortable and to produce sanitary milk it is absolutely necessary to have expensive barns. As a matter of fact, many of the dairy barns where sanitation is the primary object are quite inexpensive. On the other hand, if the barn is conveniently arranged and made to embody the most accepted sanitary features it is very essential that attention be given to plans and specifications of the barn that is to house the dairy herd to best advantage. Every detail of the new barn should be carefully worked out before actual construction begins.

The barn should be planned so that additions can be made to it with a minimum of expense, and without marring the symmetry and beauty of the structure as a whole. Not only should present needs be met, but growth and expansion of the herd in the future must be taken into consideration before the dairyman can intelligently determine the size and type of barn best suited to his business.

The present scarcity and high price of labor make it all the more important that mistakes in arrangement, which necessitate countless unnecessary steps and which require work to be done at a disadvantage day by day, year in and year out, be avoided as far as possible in the planning and equipping of the dairy barn. Mistakes are often made in locating the silo, in placing of doors, in determining proper dimensions of gutters, stalls and of platforms. Details such as these should have very careful attention so that the finished structure may be as

hygienic and labor saving as possible, and that the daily routine of the work be reduced to a minimum.

Dairy work must be done twice a day and every day in the year. Therefore, neglect in providing modern equipment means

FIG. 1—A MODERN DAIRY BARN

The main building houses milch cows, and the wing at the right contains stalls for test cows and pens for calves. The large milk house at the left is located about twenty feet from the barn.

much extra work and additional labor expense. Dairy cows consume large amounts of feed, such as hay, silage and grain, and unless care is taken to arrange for the saving of labor in the feeding of cows and calves, the process will require an unduly large amount of time. The work of milking and cleaning the barn are matters occupying much of the barn man's time and any scheme of arrangement or equipment that will lessen this phase of the work will amply justify itself from a financial point of view alone, to say nothing about the satisfaction of having done it in the most convenient manner.

LOCATION AND DRAINAGE OF BARN AND YARDS

The dairy barn should, whenever possible, be built on a high spot which has good slope, can easily be drained and is or can be sheltered from prevailing cold winds.

If wholesome and sanitary milk and cream are to be produced the farmer should realize that the cows should be kept out of the mud as much as possible. Conditions in and around the barn can in many cases be greatly improved by draining and grading.. Draining is not of itself sufficient as the tramping of the cattle soon "puddles" the surface, thus practically preventing the water from reaching the tile below. The barn yard should have good slope such as will insure good surface drainage and should have a good top layer of gravel or cinders, or better still, if the expense is not too great, a layer of concrete. In many places this may involve a great deal of work, but even if it cannot all be done in one year, arrangements should be made by which at least part of it is done every year.

SELECT SUITABLE LOCATION

In choosing the site for the dairy barn, good natural drainage is of prime importance. When the barn is located in a low spot there is a tendency for the floor of the stable, which is usually constructed of concrete, to be damp on account of the

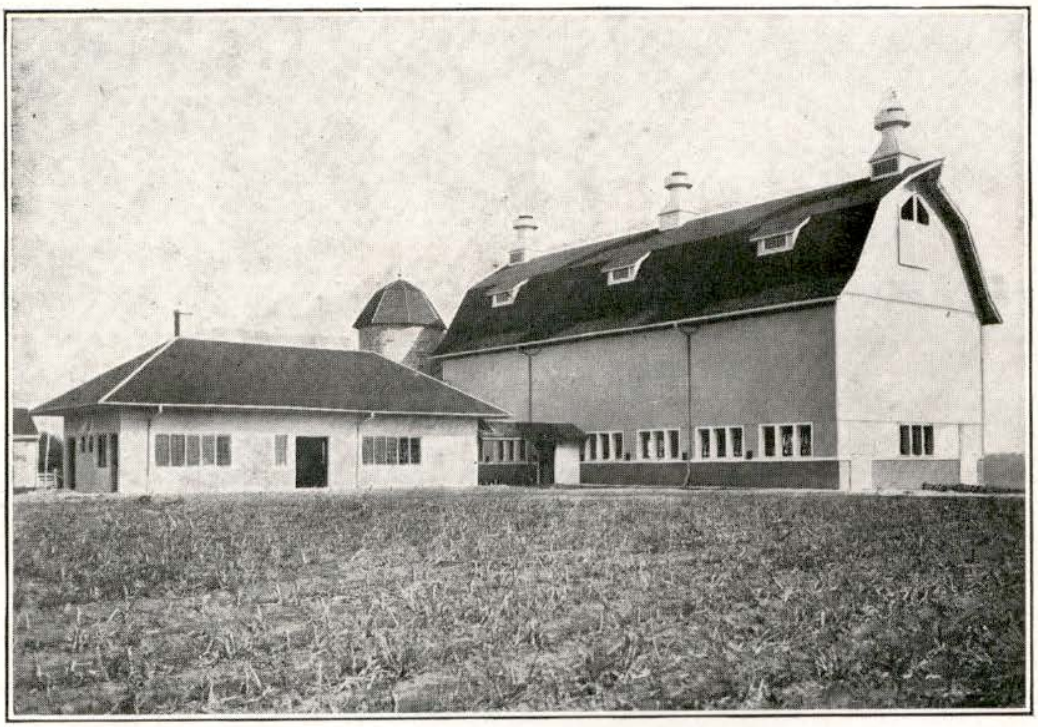


FIG. 2—A WELL-PLANNED AND SUBSTANTIAL BARN, SILO AND MILK HOUSE

In this type of barn the feed supply is very close at hand. This milk house is considerably larger and more expensive than is required under most conditions, as it is equipped for bottling milk, etc.

water entering the soil below the floor. The floors of such barns tend to be colder in winter than those which are well drained. The natural slope should be such that there is no chance for surface water to flow into the barn.

Since sunlight is of great value in the dairy barn, the most desirable direction for the barn to extend is north and south,

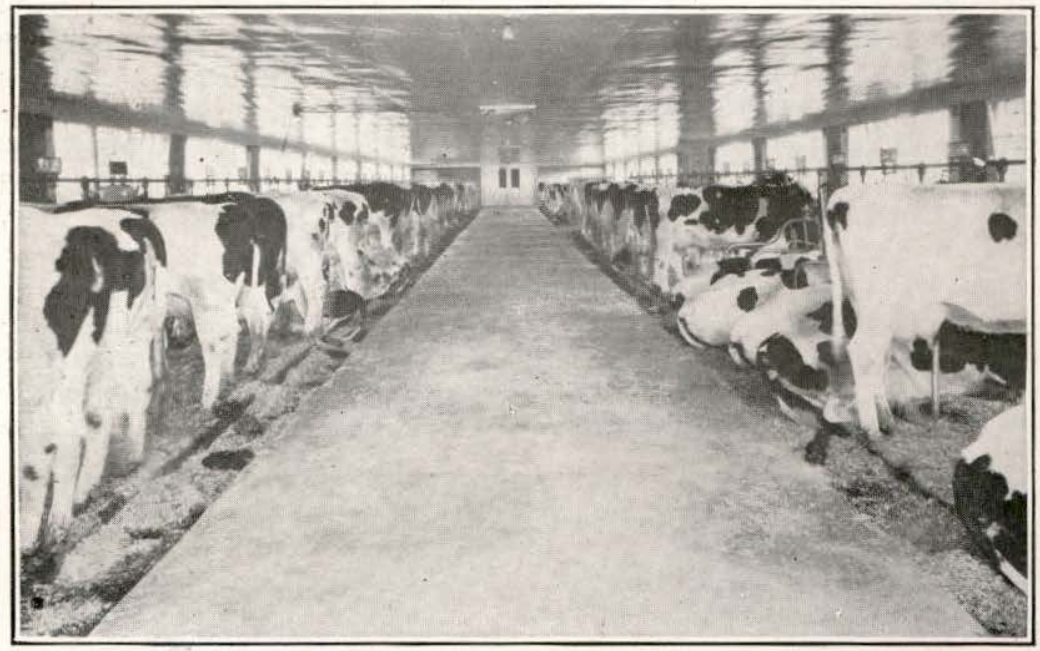


FIG. 3—INTERIOR OF A WELL-LIGHTED STABLE

which will afford opportunity for admission of the maximum amount of light to the stable.

The relation of the other farm buildings will, in a large measure, determine the location of the dairy barn. The latter should be near enough the other buildings to afford convenience in performing the farm operations, but ample space should be provided for yards for cows, young stock and bull; also for driveways for unloading feed, hauling away manure, etc.

When possible, the barn should provide a windbreak for one or more, preferably the north and west, sides of the cow yard. If the dairy barn is to be added to a group of buildings already constructed, some of the latter may sometimes be utilized as windbreaks also. If the young stock is to be housed in a separate wing of the barn, which is a desirable arrangement, this wing may be attached to the east side of the cow barn, the arrangement thus affording shelter for the north and west sides of the exercising yard.

The location of the milk house and silo must be given consideration in planning the barn. Under most conditions it is necessary to locate the milk house near the well so that water may readily be provided for the cooling tank. Where there is sufficient slope to carry the water in underground pipes or where a pressure water system is used this necessity is obviated. Under all conditions, however, the milk house should be convenient to the milking stable. If desirable to connect the milk house to the barn, it should be separated from the stable by a passage, four or more feet in length, having a door at each end, in order to prevent the entrance of barn odors. For a similar reason the milk house should not be near the silo. These structures may well be located at opposite sides of the barn.

CHOOSE THE TYPE OF BARN BEST SUITED TO YOUR SPECIAL REQUIREMENTS

The particular type of barn to be chosen is determined chiefly by local conditions and personal preference. For the production of milk of especially high grade, one story stables with storage barns connected at one end are common. While this plan may entail slightly more labor in carrying feed to

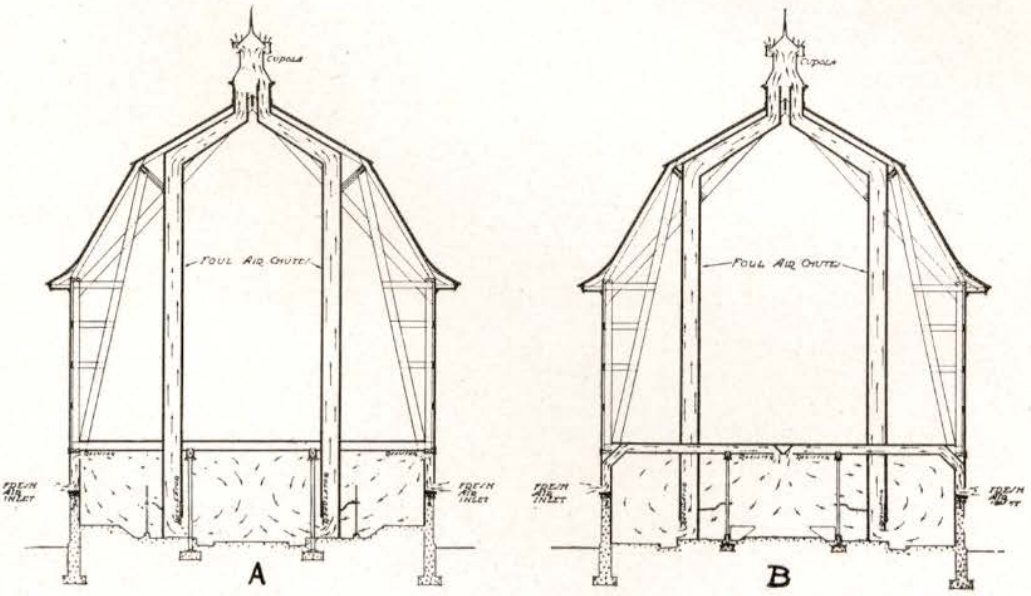


FIG. 4—METHOD OF INSTALLATION AND OPERATION OF VENTILATOR FLUES

The circulation of air is such that the fresh air enters near the cows' heads and the foul air is removed at a point near the gutters. A—Where cows face the walls. B—Where cows face the center of the barn. (Courtesy Hunt, Helm, Ferris and Company.)

the cows, it has the advantages of less expensive construction and greater mow capacity of the storage barn. A type of construction requiring the minimum amount of labor in moving feed is the two-story type of barn with feed storage above the stable, as illustrated in figure 2.

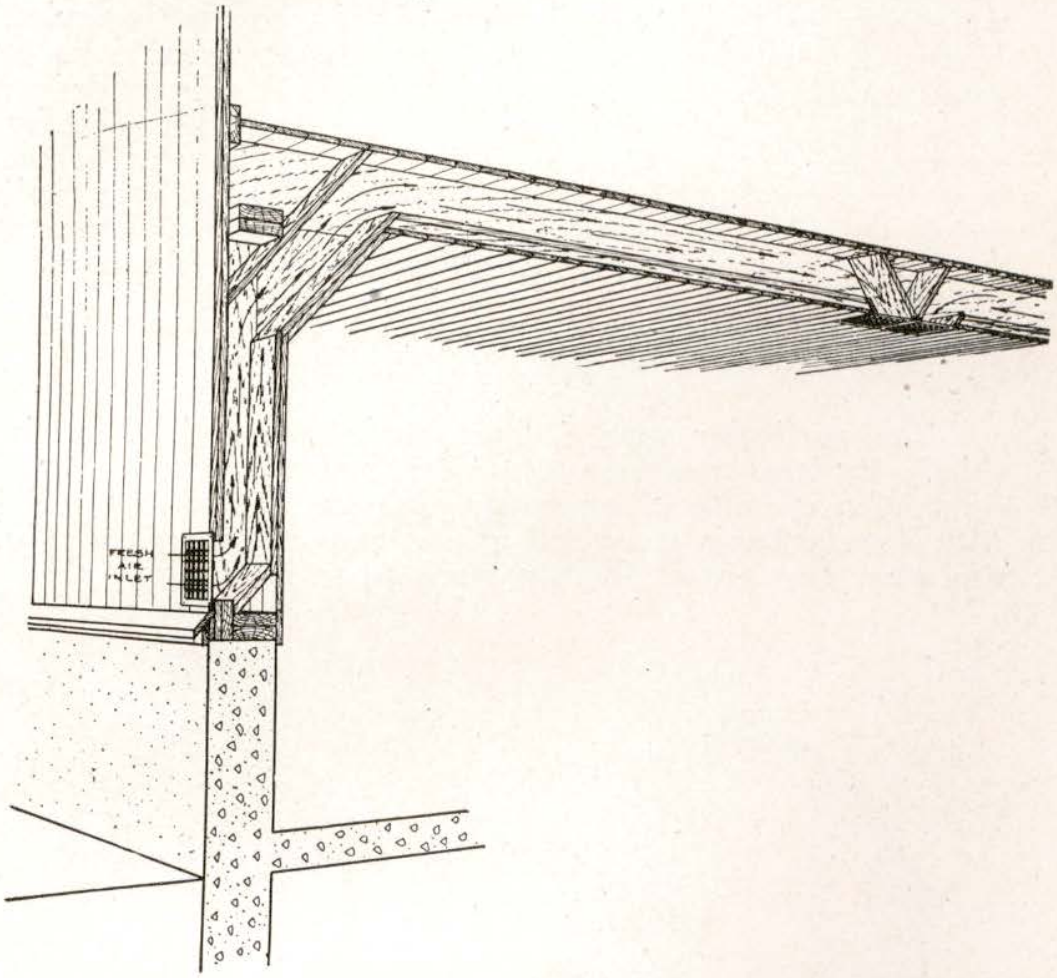


FIG. 5—METHOD OF CONSTRUCTION OF INLET FLUE WHERE COWS FACE THE CENTER OF THE BARN

The drawing illustrates flues from opposite sides of the barn opening into the stable at the same point. (Courtesy Hunt, Helm, Ferris and Company.)

There is no objection from a sanitary standpoint to having feed stored above the cows provided there is a tight ceiling in the stable to prevent dust and dirt from sifting thru from above.

In a region having a mild climate all roughage may be fed in an open shed in which the cows run loose, and the cows kept in a separate milking stable during milking hours only.

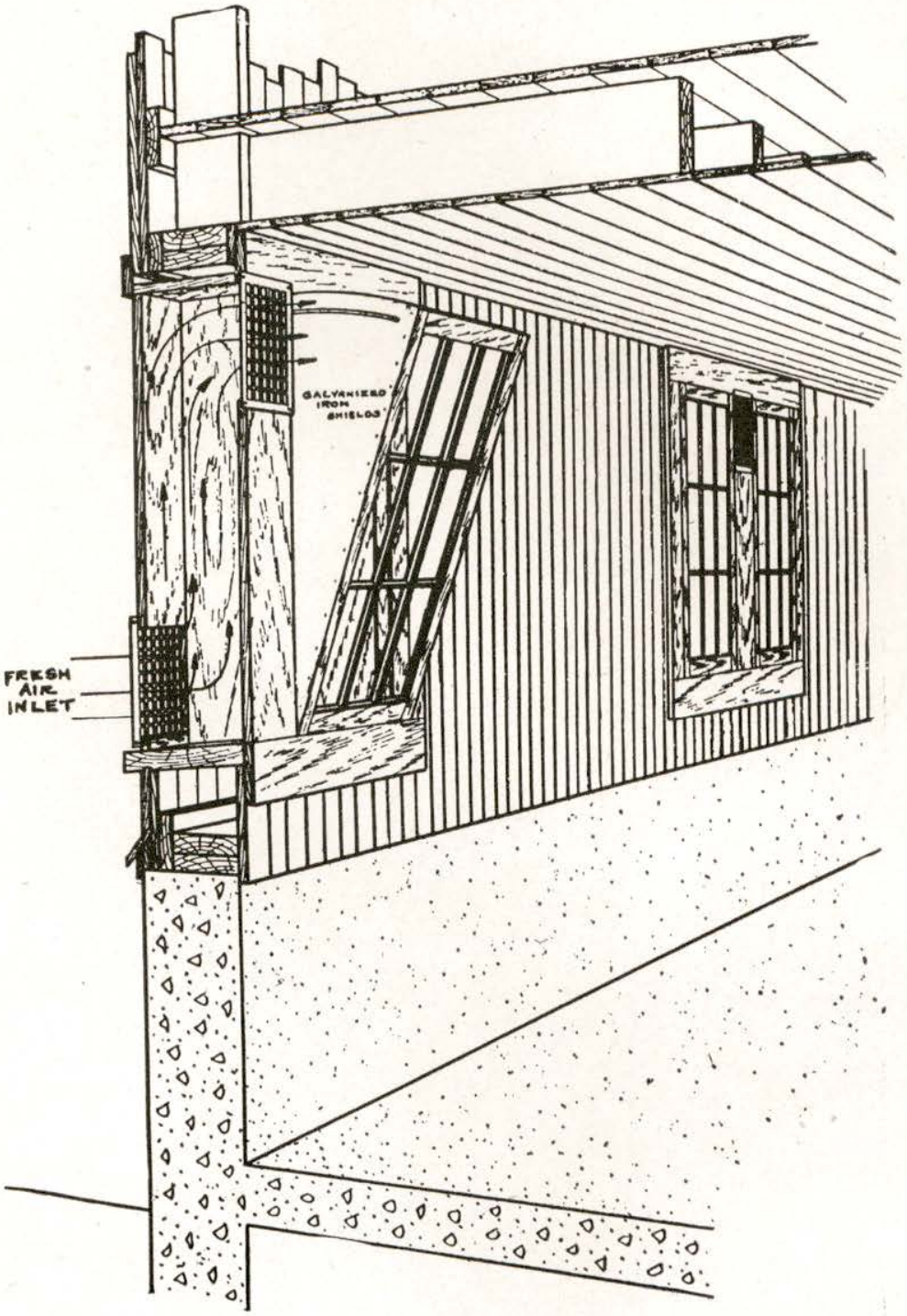


FIG. 6—INLET FLUE WHERE COWS FACE THE WALLS OF THE BARN

This illustration also shows an additional means of admitting fresh air without causing direct drafts. Windows are hinged at the bottom and galvanized iron shields are fitted to the window frames to prevent air from entering at any point except over the tops of the windows. (Courtesy Hunt, Helm, Ferris and Company.)

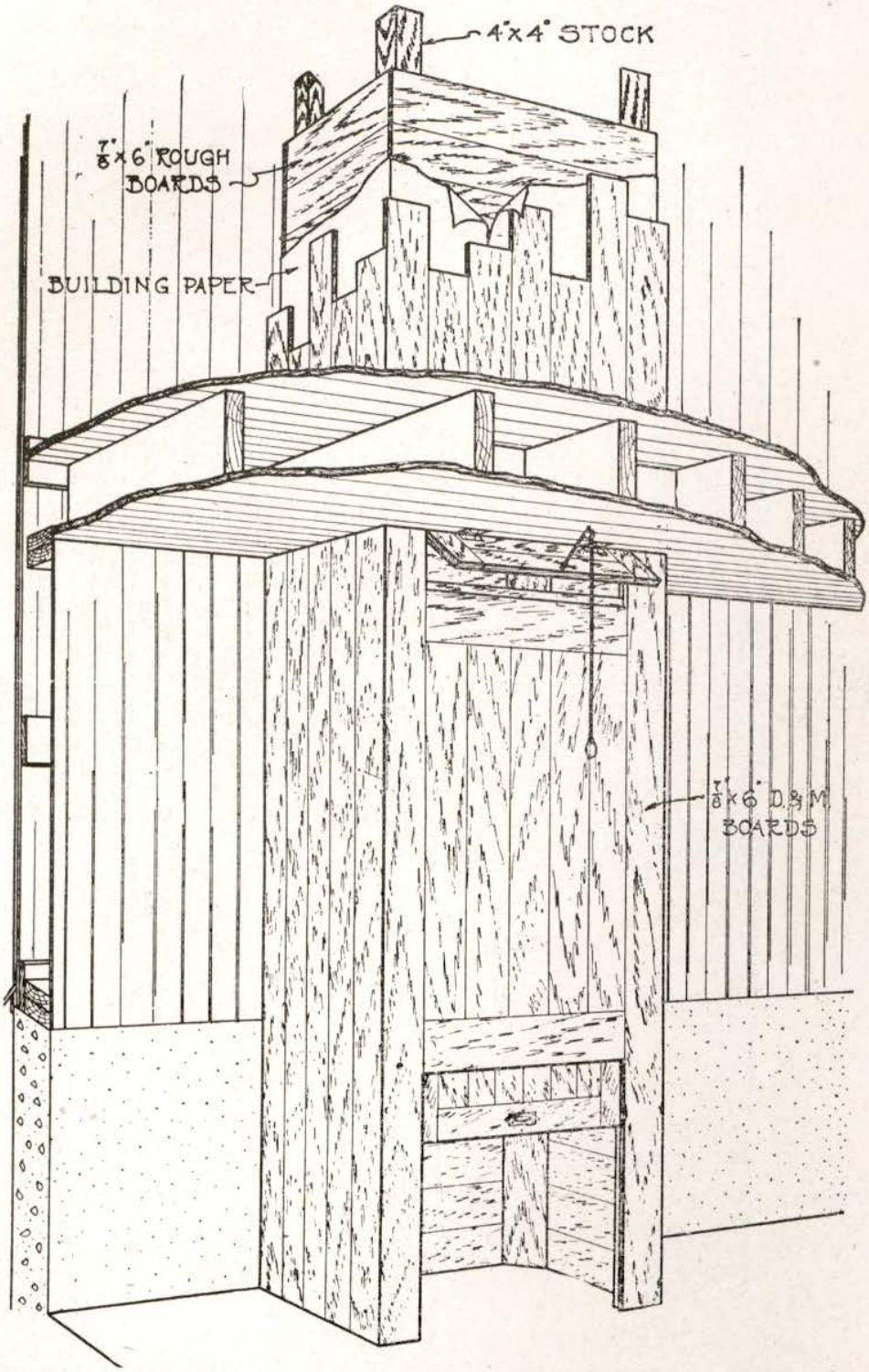


FIG. 7—METHOD OF CONSTRUCTION OF THE FOUL AIR FLUE
A valve is provided near the ceiling for cooling the stable. (Courtesy Hunt, Helm, Ferris and Company.)

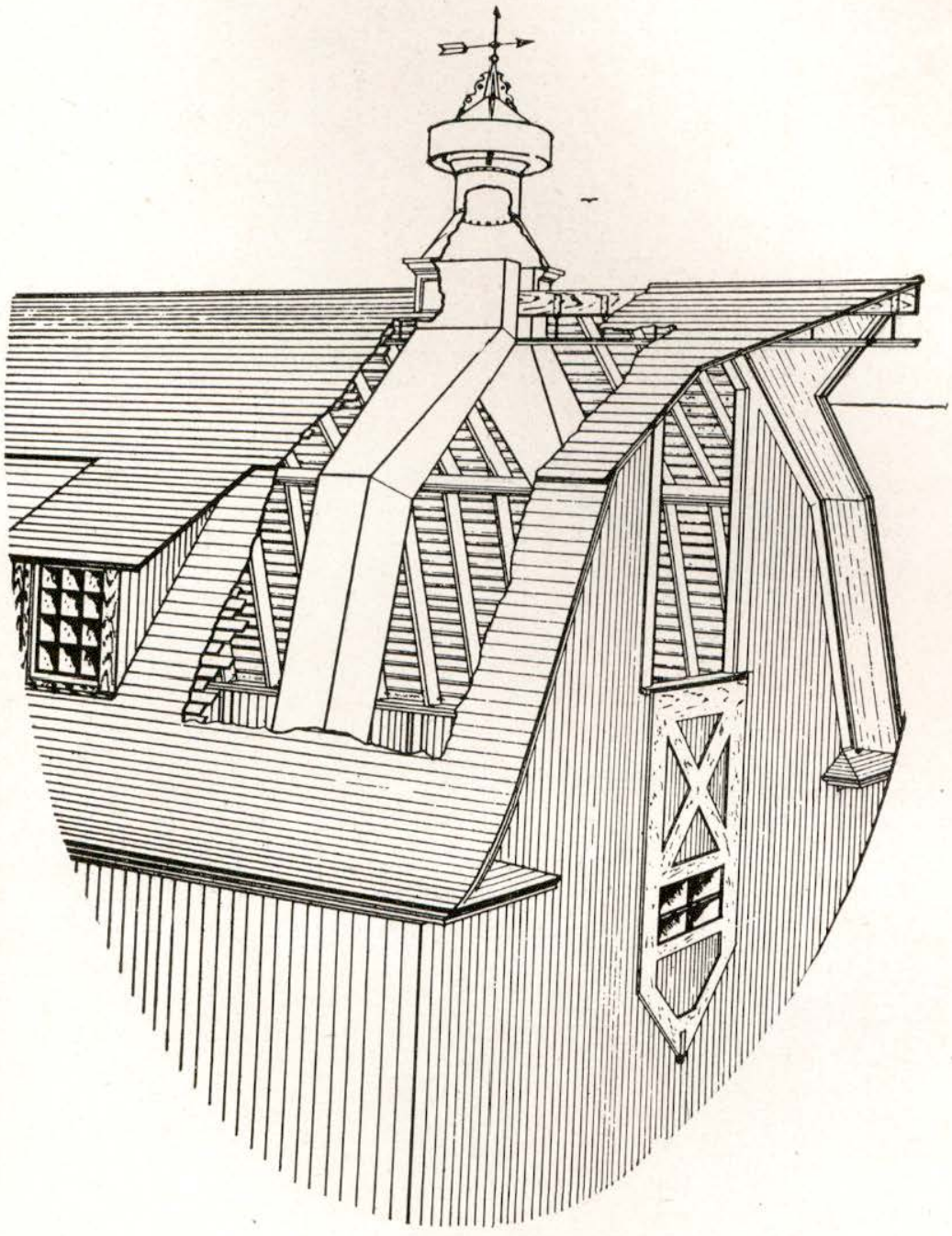


FIG. 8—METHOD OF CONNECTING TWO FOUL AIR FLUES IN ONE CUPOLA

To provide room for the hay carrier to pass between them, the flues are widened in order to retain the same capacity. (Courtesy Hunt, Helm, Ferris and Company.)

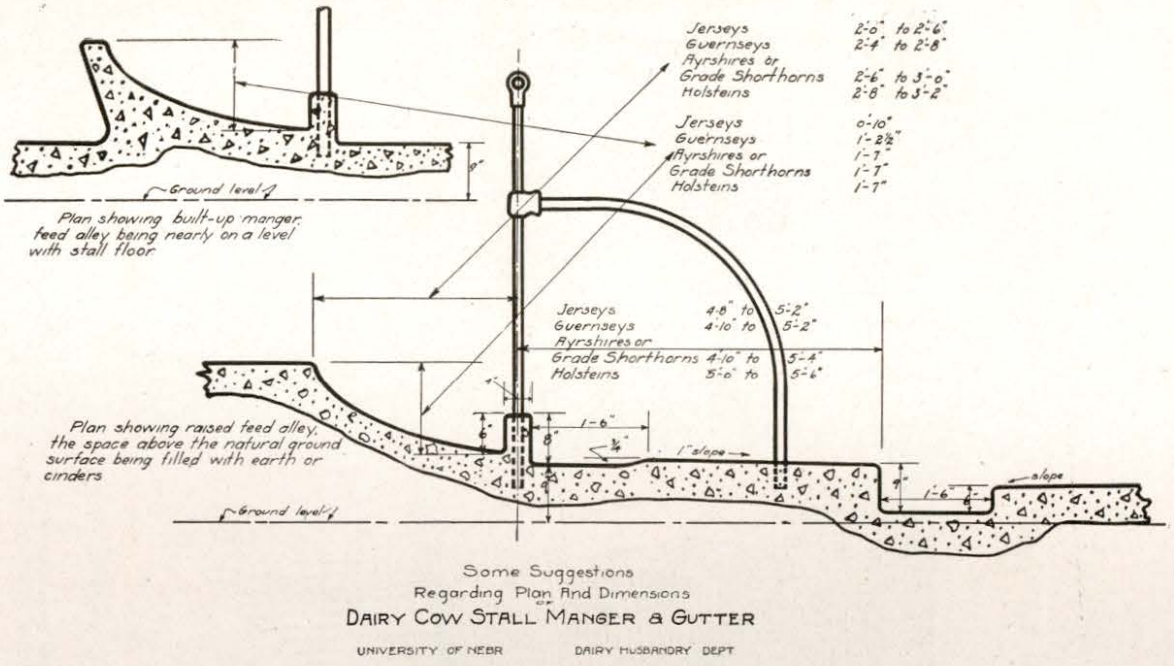


FIG. 9—CROSS-SECTIONAL VIEW OF MANGER, STALL AND GUTTER

Since cows of different breeds differ greatly in size, the length of the stall and the width and depth of the manger should be chosen to fit the requirements of the animals.

This system may be labor saving but requires a large amount of bedding in order to keep the cows clean.

The round or circular barn offers the maximum convenience in feeding when the arrangement is such that the silo and hay chute are located in the center of the barn and the cow stalls are arranged in a circle facing the center. On account of its many limitations, however, the circular type is suited to but few conditions.

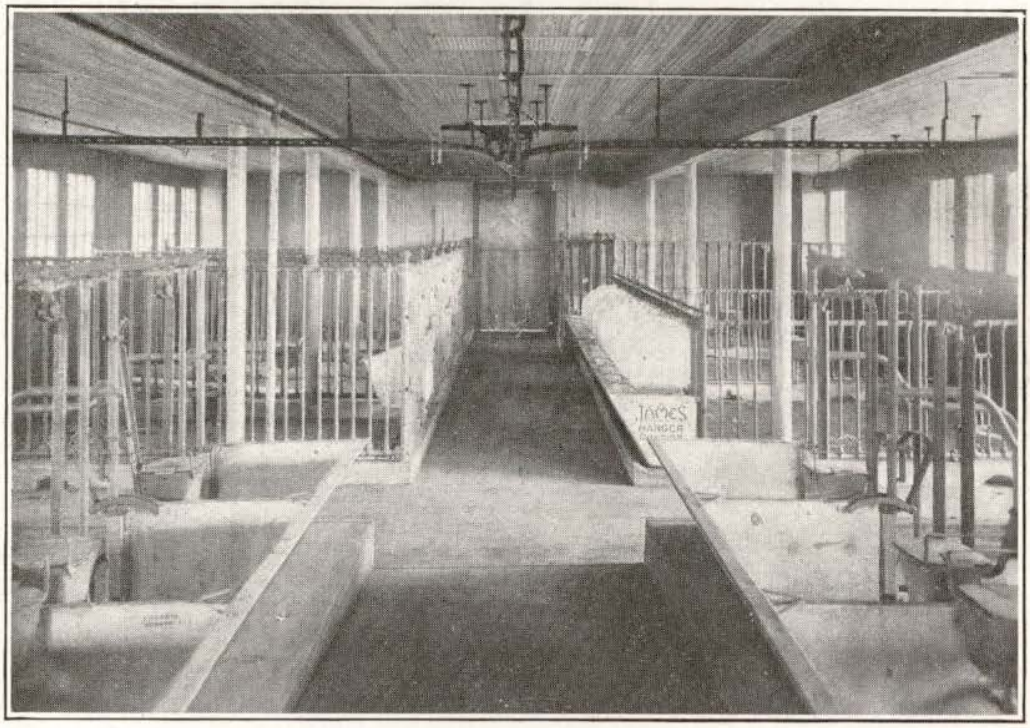


FIG. 10—PART OF THE INTERIOR OF THE BARN SHOWN IN FIGURE 2

This type of barn is not advocated for general farm conditions but may be of interest to the specialized dairyman and illustrates some of the possibilities in equipping dairy barns to secure maximum conveniences and comfort. In the foreground are shown steel mangers and partitions which are equipped with springs to enable them to be readily lifted for cleaning; also swinging stanchions and individual water bowls. Note the high partitions between the stalls to prevent the calves from sucking each other. In the left background are shown box stalls for cows, equipped with mangers which tilt into the alley, and also water bowls. Above, a litter carrier track is shown, and in the ceiling the openings of the fresh air flues covered by registers.

No matter what type of barn is chosen, the aim should be to have it as convenient as possible, since with the exception of feed, labor is the largest item in the cost of milk production.

Permanence in construction is a subject receiving a greater degree of consideration each year. Now that the labor cost of construction, depreciation, rpairs and insurance form such large

items in the case of temporary structures, monolithic concrete, concrete blocks and vitrified tile are being employed to some extent. In such buildings there must be a dead air space in the walls of the stable to prevent condensation of moisture which is sure to occur on solid masonry walls. The appearance

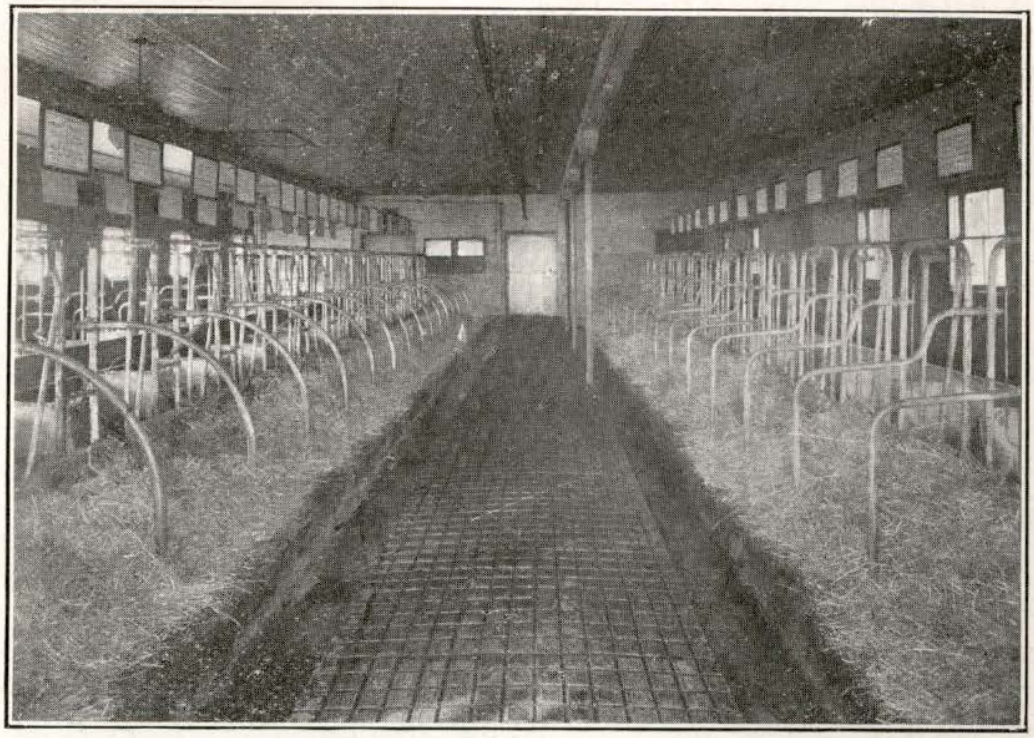


FIG. 11—INTERIOR OF THE UNIVERSITY OF NEBRASKA DAIRY BARN
This shows how the concrete walk is indented in order to prevent cows from slipping. This device has proved quite satisfactory.

of the finished building usually receives sufficient attention in the erection of a dwelling house, but is often overlooked in the case of the dairy barn. There is no reason why the outside appearance, as well as the interior arrangement, should not be considered when planning the barn, as it costs but little, if any, more to have the barn present a good architectural appearance. The day when every farmer planned his own barn is past.*

The type of barn best fitted to meet particular requirements will depend to some extent upon the amount of feed which is to be stored. In some cases much of the hay is stored in a comparatively inexpensive hay barn or in stacks, and when straw is used for bedding it is drawn directly from the stack.

*Plans may be obtained from the Agricultural Engineering Department, University of Nebraska, at a price just covering the cost of the blueprint paper.

In this case but little mow space is required. Under most conditions ample storage space will greatly facilitate caring for the herd especially during stormy weather, and will prevent waste of feed and bedding by exposure to the weather. the following tables show the amount of storage space required for dry feed and bedding per cow and also size of silo for herds of various sizes.

TABLE 1—STORAGE SPACE REQUIRED PER COW PER YEAR BASED ON BARN FEEDING PERIOD OF 200 DAYS

Item	Pounds required daily	Tons required per year	Cubic feet of space required
Hay	10-15	1-1½	525-788
Straw (bedding)	5-10	½-1	275-550
Sawdust	10-15	1-1½	150-225
Shavings (baled)	5-10	½-1	80-160
Grain	8-12	.6-1.2	75-100

NOTE—For size of silo required see table 2.

A ton of hay settled not more than 30 days requires about 590 cubic feet of space, either in the mow or in the stack, but when settled from 75 to 155 days requires only about 515 cubic feet. To find the capacity of a bin in bushels, multiply together the number representing the depth, width and length in feet, and divide by 1.25, or multiply by 0.8.

TABLE 2—APPROXIMATE SIZE OF SILOS REQUIRED[1]

No. of cows in herd	When fed 40 pounds per day for 180 days			When fed 40 pounds per day for 240 days		
	Tons of silage required	Diameter of silo (feet)	Height of silo (feet)	Tons of silage required	Diameter of silo (feet)	Height of silo (feet)
10	36	10	28	48	10	34
15	54	12	30	72	12	35
20	72	12	35	96	12	44
25	90	14	34	120	14	42
30	108	14	38	144	14	46
35	126	14	42	168	16	42
40	144	16	38	192	16	48
45	162	16	42	216	16	50
50	180	16	45	240	16	55

[1]Computed from Nebraska Agricultural Experiment Station Circular No. 1.

TABLE 3—RELATIVE CAPACITIES OF SILOS AND ESTIMATED TONNAGE OF SILAGE BY VOLUME[1]

Depth of silage in feet when filling ceased	Diameter of silo in feet								
	10	11	12	13	14	15	16	17	18
1	.63	.77	.95	1.07	1.24	1.42	1.62	1.83	2.06
2	1.33	1.60	1.91	2.24	2.60	2.98	3.40	3.88	4.31
3	2.07	2.52	2.99	3.51	4.15	4.67	5.32	6.01	6.74
4	2.88	3.49	4.16	4.88	5.66	6.50	7.39	8.35	9.37
5	3.75	4.54	5.40	6.33	7.35	8.44	9.65	10.85	12.18
6	4.68	5.65	6.71	7.89	9.15	10.52	11.96	13.52	15.16
7	5.64	6.84	8.12	9.54	11.07	12.70	14.45	16.32	18.32
8	6.68	8.03	9.60	11.27	13.06	15.00	17.08	19.30	21.64
9	7.75	9.38	11.16	13.09	15.17	17.43	19.84	22.42	25.14
10	8.84	10.76	12.78	15.44	17.40	19.96	22.72	25.69	28.78
11	10.08	12.16	14.48	16.98	19.70	22.62	25.72	29.08	32.60
12	11.30	13.64	16.25	19.05	22.10	25.36	28.89	32.64	36.57
13	12.53	15.18	18.07	21.20	24.60	28.24	32.22	36.32	40.67
14	13.90	16.89	20.00	23.46	27.20	31.22	35.54	40.18	44.97
15	15.24	18.45	21.96	25.76	29.90	34.53	39.08	44.10	49.40
16	16.75	20.19	24.00	28.16	32.68	37.50	42.67	48.40	54.00
17	18.12	21.95	26.11	31.30	35.50	40.68	46.39	52.45	58.75
18	19.60	23.77	28.28	33.30	38.45	44.19	50.27	56.75	63.61
19	21.16	25.62	30.49	35.75	41.50	47.68	54.05	61.25	68.64
20	22.78	27.55	32.75	38.45	44.60	51.23	58.28	65.83	73.80
21	24.40	29.52	35.14	41.23	47.80	54.90	62.48	70.54	79.13
22	25.96	31.54	37.54	44.05	51.10	58.80	66.70	75.32	84.48
23	27.14	33.61	40.00	46.95	54.40	62.50	71.80	80.30	90.00
24	29.50	35.67	42.45	49.85	57.80	66.30	75.48	85.27	95.53
25	31.30	37.85	45.20	52.83	61.30	70.38	80.00	90.36	101.25
26	33.08	40.00	47.66	55.45	64.80	74.40	84.64	95.54	107.22
27	34.92	42.21	50.28	59.00	68.40	78.62	89.30	100.85	113.20
28	36.78	44.50	53.00	62.13	72.10	82.80	94.10	106.25	119.25
29	38.67	46.80	55.75	65.31	75.80	87.10	98.90	111.75	125.40
30	40.60	49.16	58.50	68.60	79.50	91.30	103.80	117.30	131.60
31	.....	.....	61.27	71.90	83.37	95.75	108.80	122.90	137.90
32	.....	.....	64.12	75.20	87.20	100.20	113.80	128.60	144.35
33	.....	.....	67.00	78.50	91.10	104.60	118.90	134.40	150.80
34	.....	.....	69.82	82.10	95.10	109.20	124.20	140.25	157.35
35	.....	.....	.....	.....	99.10	113.80	129.30	146.10	163.90
36	.....	.....	.....	.....	103.20	118.50	134.70	152.15	170.70
37	.....	.....	.....	.....	107.20	123.10	139.90	158.15	177.40
38	.....	.....	.....	.....	111.30	127.80	145.30	164.20	184.20
39	.....	.....	.....	.....	115.50	132.60	150.80	170.30	191.20
40	.....	.....	.....	.....	119.60	137.40	156.20	176.40	198.10
41	.....	.....	.....	.....	123.80	142.20	161.70	182.70	205.10
42	.....	.....	.....	.....	128.20	147.20	167.40	189.00	212.05
43	.....	.....	.....	.....	.....	152.00	172.90	195.30	219.20
44	.....	.....	.....	.....	.....	.....	178.60	201.80	226.30
45	.....	.....	.....	.....	.....	.....	184.20	208.20	233.60
46	.....	.....	.....	.....	.....	.....	190.00	214.70	240.85
47	.....	.....	.....	.....	.....	.....	195.80	221.30	248.20
48	.....	.....	.....	.....	.....	.....	201.80	227.90	255.65
49	.....	.....	.....	.....	.....	.....	207.70	234.50	263.20
50	.....	.....	.....	.....	.....	.....	213.60	241.20	270.75

[1]Nebraska Agricultural Experiment Station Circular No. 1.

Note—To calculate the weight of the silage remaining in the silo after it has been partially emptied first find from the above table the amount of silage in the silo when filling ceased. Then find the capacity of the silo for the space which has been emptied and subtract this from the first. The difference is the amount of silage remaining in the silo. For example, 10 feet of silage remains in a 14-foot silo which was filled to a depth of 40 feet. The above table indicates that there were 119.6 tons of silage put in the silo and that a space 14 by 30 feet would contain 79.5 tons. Hence the difference, 40.1, indicates the number of tons remaining in the silo.

PROVIDE AS MUCH LIGHT IN THE BARN AS POSSIBLE

A large amount of window space is one of the essential features of a well-planned dairy barn. Stables which have too much light are very rare. An abundance of sunlight aids in keeping the barn clean and dry and makes the surroundings pleasant for both men and animals.

Most score cards in use by various boards of health specify that there be four square feet of glass per cow. The amount of light in the stable does not depend directly upon the amount of glass, however. In barns over 40 feet in width the windows

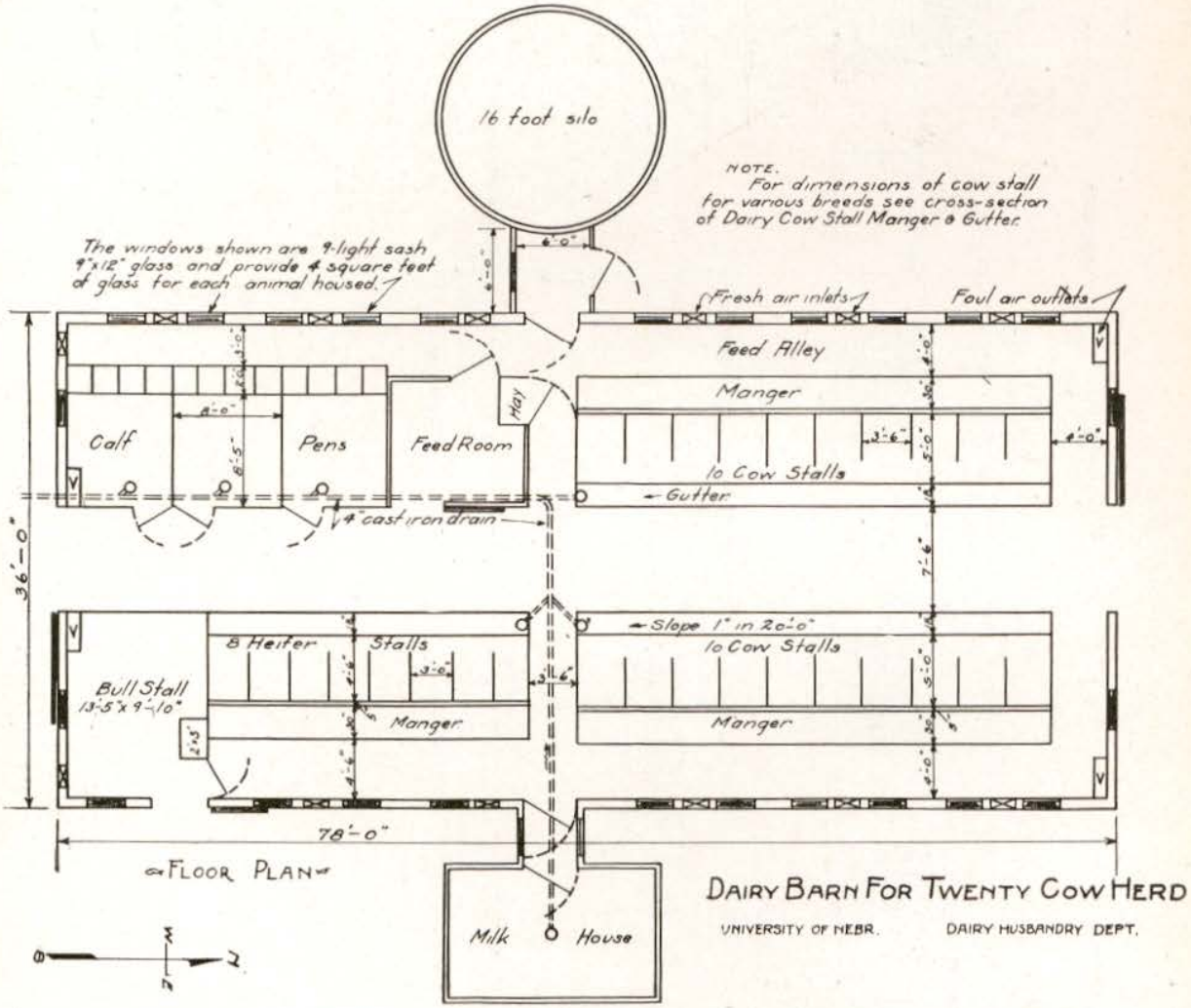


FIG. 12—SUGGESTED ARRANGEMENT OF FIRST FLOOR IN BARN OF TWENTY-COW HERD

The outtake flues at the south of the barn have been located near the center in order to have them as straight as possible. In case hay is taken into the mow at this end, the flues may be located a few feet farther from the center.

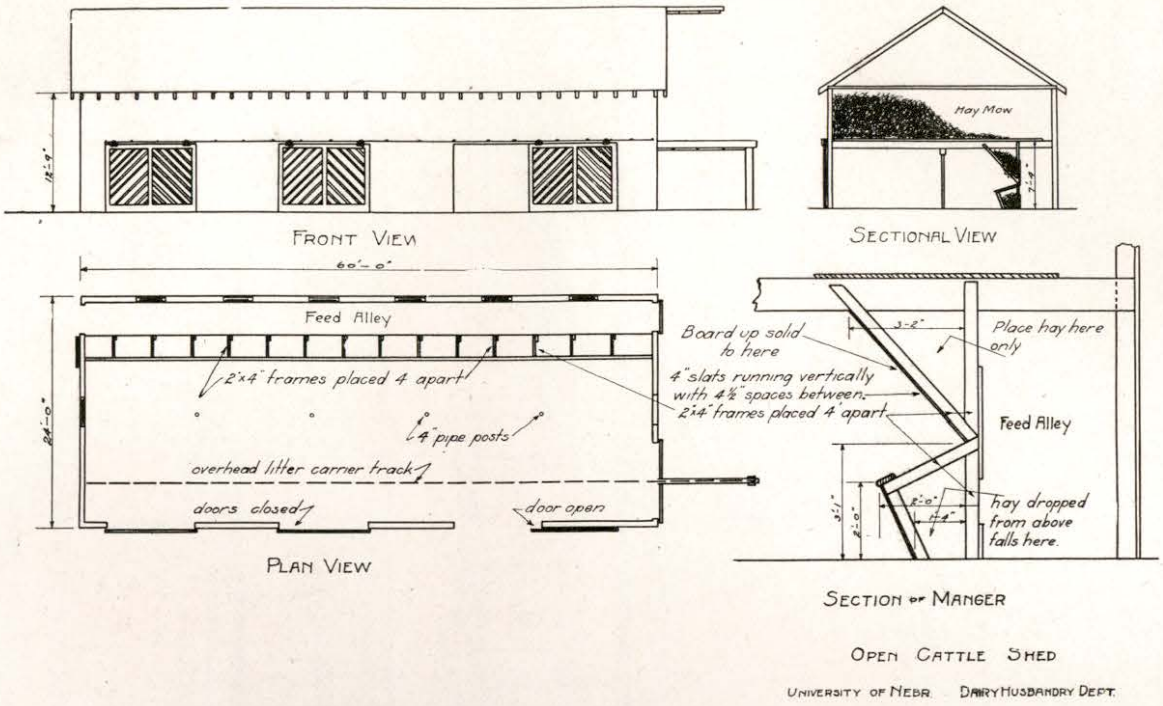


FIG. 13—PLAN OF OPEN SHED IN USE AT THE UNIVERSITY OF NEBRASKA

Dry cows and heifers may be housed and fed roughage in this shed with the expenditure of but little labor. This arrangement was also found of advantage in summer for feeding soiling crops and providing shade for cows being tested for advanced registry. The large doors on the south side are closed only during the coldest weather.

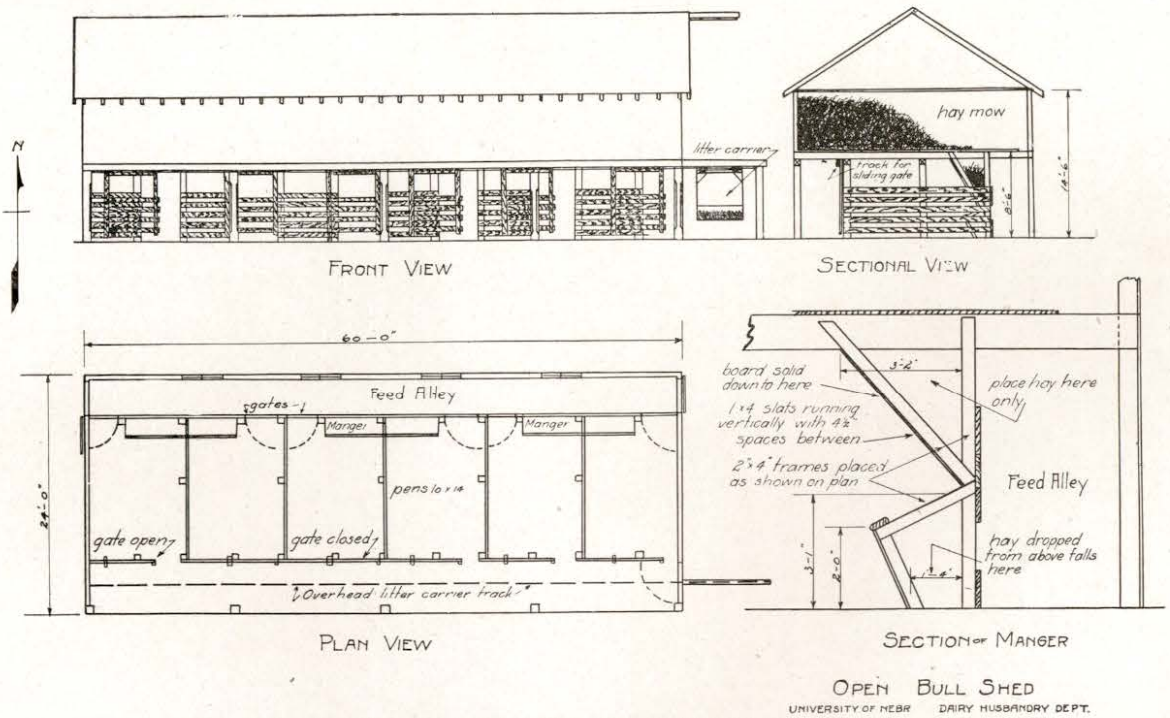


FIG. 14—PLAN OF OPEN BULL SHED AT THE UNIVERSITY OF NEBRASKA

The barn faces the south and is open on that side. The sliding gates of the pens are hung from a standard barn-door track and slide very easily. Exercising yards connect with the pens. This barn is much larger than is required under average farm conditions.

are too far from the center of the barn to light it well. As previously stated the maximum amount of light is admitted to a rectangular barn when it stands in a north and south direction provided windows are evenly distributed on all sides of the barn. For most efficient lighting the windows should be placed vertically in the wall and as high as possible. On account of the danger of breakage they should not extend nearer to the floor than a distance of four feet. A rough, dark surface reflects but little light. If the stable ceiling and walls are smooth and light in color the efficiency of the windows is greatly increased. Whitewash and cold water paint are comparatively cheap coverings for inside work which may be used to secure this effect.

VENTILATION IS NECESSARY FOR HEALTH

One of the features often overlooked but of great importance in keeping animals in good health is a proper system of ventilation. In well-built barns it is possible to keep the stable at a comfortable temperature and yet provide the animals with a constant and ample supply of fresh air without direct drafts blowing upon them. The plan of removing the foul air thru outtake flues opening near the stable floor and admitting fresh air thru flues opening at the ceiling, known as the King system, has proved generally satisfactory.

Under this system fresh air is admitted thru a large number of small flues distributed as equally as possible in the walls of the stable. The flues should be three or more feet in length to prevent air flowing outward. The method of operation of the fresh air inlets is illustrated in figure 4. Where the cows face the center of the barn the flues extend from the side walls between the ceiling of the stable and floor of the haymow, opening at the center of the stable. The width of the flues is usually the extent of the space between two adjacent floor joists. When the stable is arranged so that cows face the walls of the barn, the flues open on the inside of the wall near the ceiling, thus admitting the fresh air in front of the cows. It is well to have the outside opening of the flues protected by a grating or screen wire to prevent birds and trash from entering.

The foul air outtakes are much fewer in number than the inlet flues but have a total cross sectional area equal to that of the inlet flues. These flues should have as few bends and turns as possible, be smooth on the inside and extend above the ridge of the barn. Figure 7 illustrates the proper method of construction of the outtake flues. Galvanized iron pipes do not

form satisfactory outtake flues in cold climates on account of the condensation of moisture, accumulation of frost and the rapid cooling of the air passing thru them. Whenever possible it is best to have the foul air flues located near the gutters. The circulation of air in the flues is primarily dependent upon a difference in temperature of the air in the stable and that

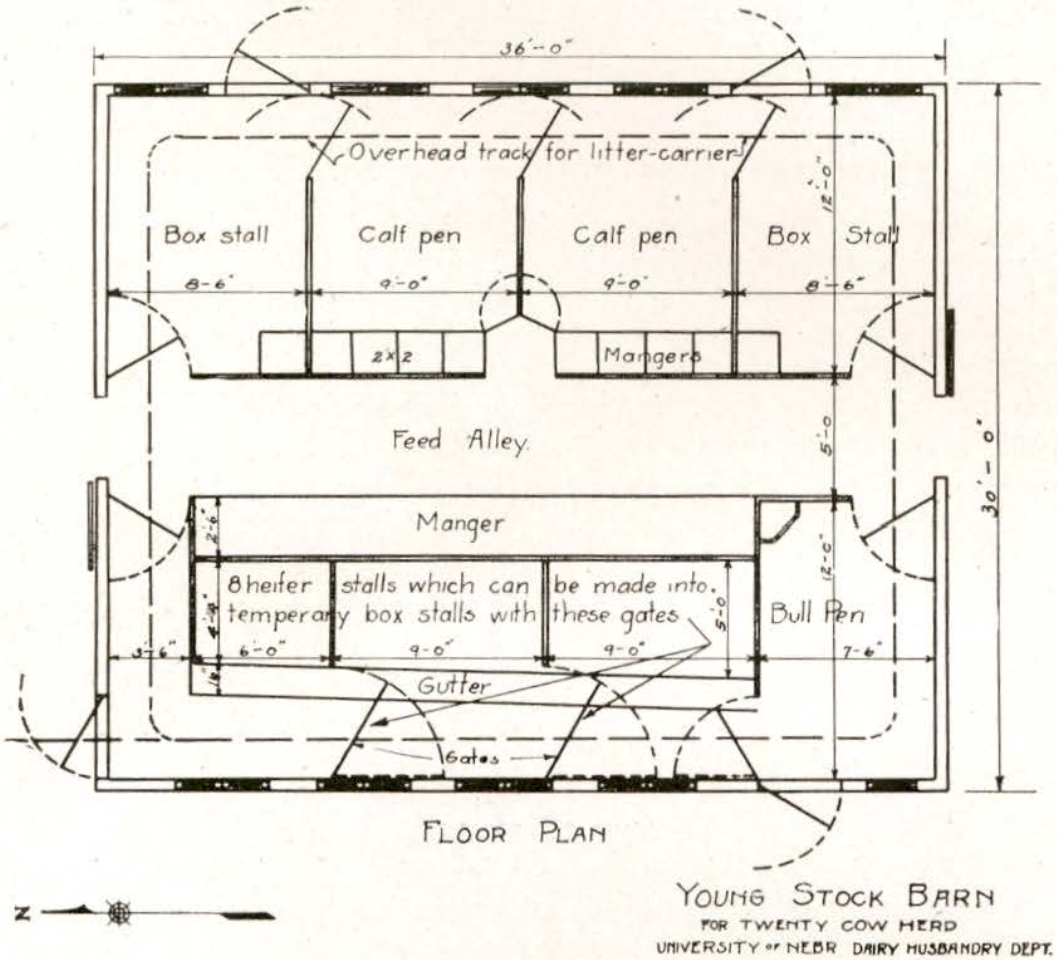


FIG. 15—FIRST FLOOR PLAN OF YOUNG STOCK BARN SUITABLE FOR HERD OF TWENTY COWS

outside, altho wind pressure also tends to cause a circulation. It cannot be expected that the system will be effective if doors and windows are left open or if the walls are not built tight enough to prevent wind blowing directly into the stable.

The size of the flues necessary is determined by the number of animals housed and not directly from the size of the stable. According to King[1] about 30 square inches of cross sectional

[1]F. H. King, Ventilation for Dwellings, Rural Schools and Stables, p. 120.

area is required per cow when the outtake flues have a height of 30 feet and there is a difference between the temperature of the stable and that outside of 20 degrees F. Thus an outtake flue two feet square and inlet flues having an equal area should, under average conditions, provide sufficient ventilation for a stable for 20 cows. It is advisable to provide an abundance of flue space and to equip the openings with slides or registers so that the rate of circulation can be reduced in extremely cold or windy weather.

THE ARRANGEMENT OF THE STABLE IS VERY IMPORTANT

The proper arrangement of the stable is the point deserving the most careful consideration when planning the dairy barn. The superstructure of a dairy barn might be indentical with that of a horse barn or cattle barn and still meet all requirements, but upon the first floor arrangements depend the success or failure of the structure from the standpoint of being suitable for the economical production of clean milk.

GENERAL ARRANGEMENT

Convenience demands that the cows should generally be arranged in two rows lengthwise of the stable. This requires a barn 34 to 38 feet in width. Whether the two rows of cows face each other or whether they face the walls of the barn is a matter to be determined under individual conditions, altho the latter arrangement is especially advantageous where milking machines are used and in large herds where it is desirable to drive a wagon or manure spreader thru the barn for cleaning.

SIZE OF STALLS

When the stall is of proper length and width and is accompanied by a wide and deep gutter but a small amount of bedding and labor is involved in keeping the cows clean. The length of the stall platform should vary to suit the cows of a particular breed. The requirements for cows of the various breeds are shown in figure 9. The platform length may be varied in different stalls to suit both small and large cows of the same breed. For example, in the case of stalls for Jerseys, the platform may be 4 feet 8 inches long at one end of the stable and have a regular increase up to 5 feet 2 inches at the other end. If the platforms of the stalls in both rows are built in this way the shortest stalls of each row should be at opposite ends of the barn. A slight depression in the stall floor next to the curb aids in retaining bedding in the front part of

the stall and in preventing the cows from slipping when reaching for feed.

The gutter should be large enough to contain all the manure for a period of 24 hours without being filled so that the cows become soiled in lying down. This usually requires a gutter having a width of 18 to 20 inches and a depth of 8 to 10 inches below the level of the stall floor. The walk back of the

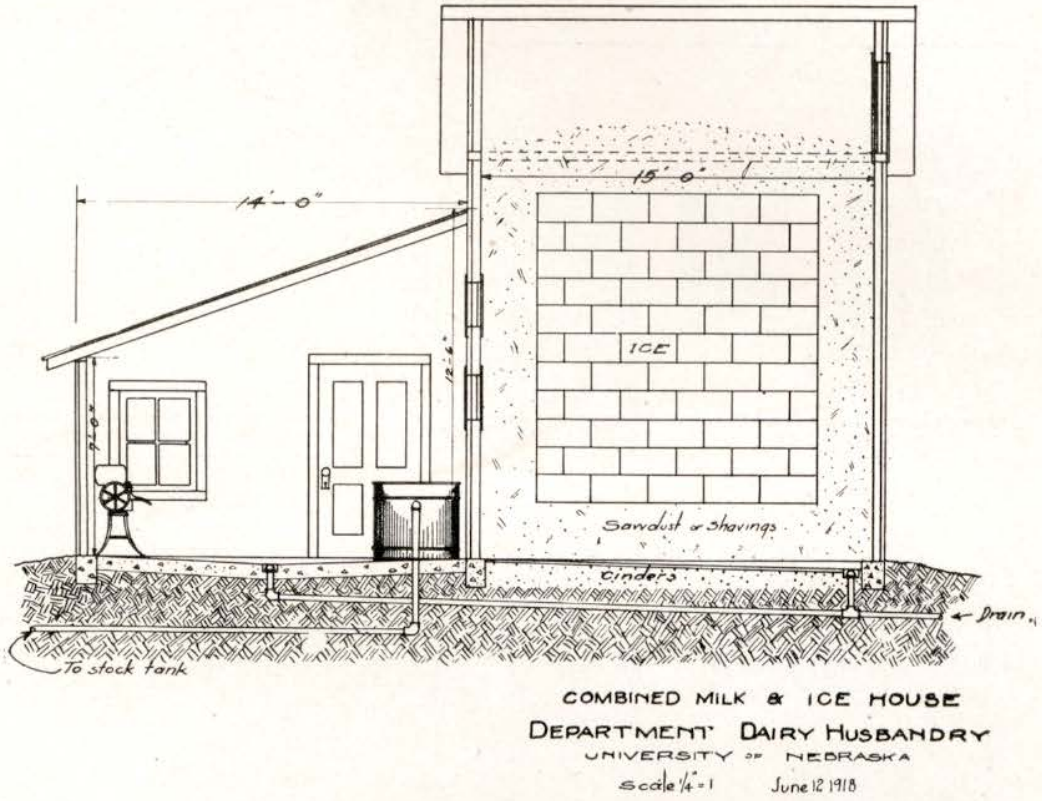


FIG. 16—PLAN OF SMALL MILK AND ICE HOUSE

This type is suitable for the dairy that sells cream or milk in bulk. A milk house of this size provides space for a milk scale, record sheets, separator, cooling tank, wash sink and Babcock test outfit.

cows is often built 2 to 4 inches lower than the stalls, so that the depth of the gutter next the walk is but 6 to 8 inches.

The width of individual stalls is usually three and one-half feet, tho large cows of the Holstein breed may require stalls four feet in width. Partitions between the stalls are very desirable, since they prevent one cow from causing injuries by stepping upon the udder or teats of another cow which is lying down. The partitions also prevent cows moving about during

milking and also permit all cows to lie down when they wish. Bent steel tubing is a satisfactory material for the partitions.

MANGERS

There are two principal styles of mangers in common use, the built-up manger and the one built below the level of the feed alley, commonly called the raised feed alley type. The built-up manger may be constructed of steel with a concrete

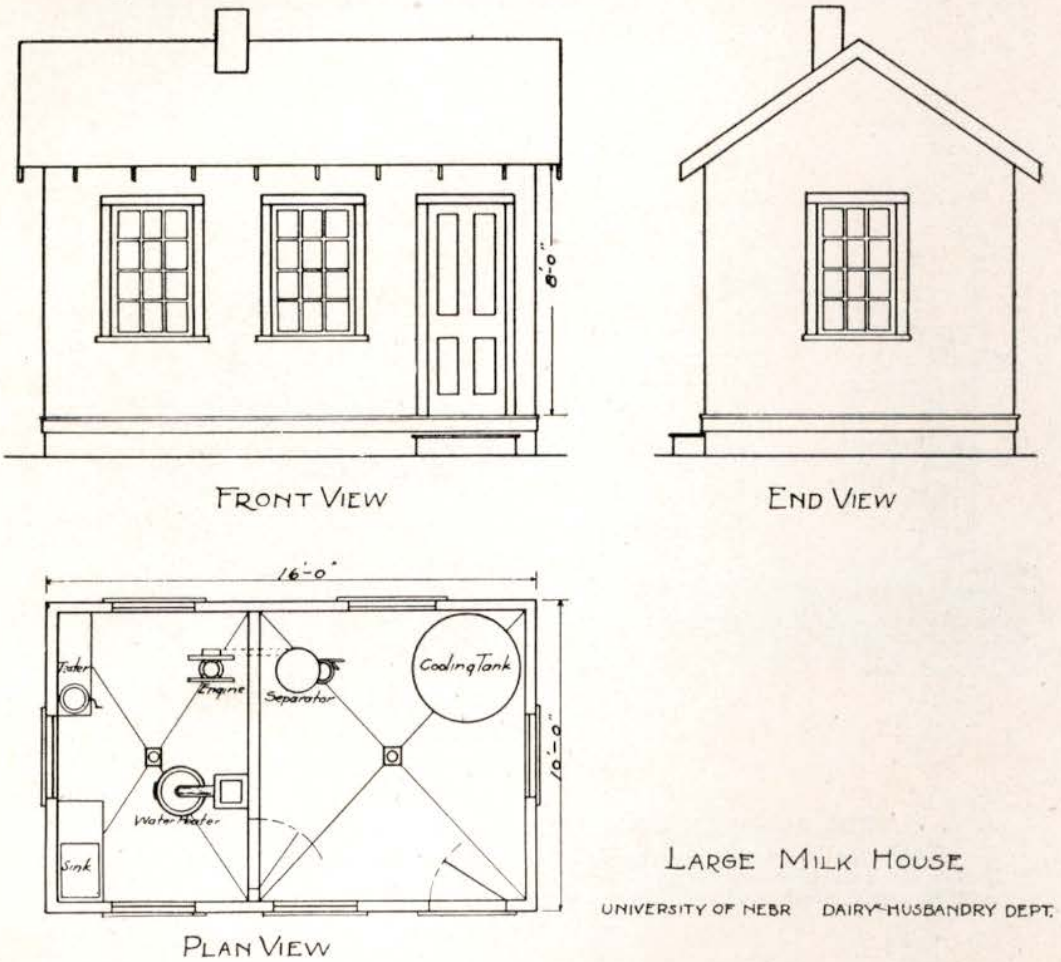


FIG. 17—PLAN OF LARGE MILK HOUSE

This plan provides space for bottling equipment as well as equipment mentioned in connection with figure 16.

floor as shown in figure 10 or entirely of concrete as illustrated in figure 9. In the raised feed alley type, illustrated in the lower part of figure 9, the feed alley floor is at the level of the tops of the mangers, this arrangement facilitating

the sweeping of feed which has been pushed out of the mangers back into them. Under this plan the feed alley floor is 18 inches or more higher than the stall floor.

A common defect in the construction of mangers is that there is not sufficient depth nor width to prevent the cows from constantly throwing feed out of the mangers. In reaching for this feed, cows often injure their knees. With the larger sized stalls, larger mangers are also recommended.

FLOORS

The most satisfactory material for the construction of the stable floor is concrete, since this is durable, economical and may be easily cleaned. Concrete is a fairly good conductor of heat and moisture and some precautions should be taken to keep the stall floor dry and warm. If built on low wet ground, a layer of cinders or gravel should be used as a foundation for the stall floors. At a somewhat greater cost than for concrete, cork bricks or creosoted wood blocks, which are manufactured especially for this purpose, may be used for the stalls. These materials are non-conductors and are quite durable.

The surface of all concrete walks over which the cows pass should be left rough to prevent slipping. The surface may also be indented or grooved in a regular pattern as illustrated in figure 11.

CEILINGS

The height of ceilings differs somewhat according to individual preferences or needs and the severity of the climate. The material used for the ceiling should be smooth and well matched so that there will be no place for dust and cobwebs to collect. The old-fashioned loft floor gives a chance for dust, cobwebs and dirt to collect on the barn as well as on hay that invariably hangs down thru the cracks, making it impossible to secure sanitary conditions. When a tight ceiling is used, there is no chance for dust to fall thru even when work is done in the loft.

BARN EQUIPMENT

Barn work may be greatly facilitated and much labor saved by the use of modern barn equipment. The swinging stanchion, besides being convenient to use, gives the cow great freedom of movement and yet keeps her in proper alignment with the gutter. Steel mangers so constructed that they may be easily and quickly lifted for cleaning are on the market, as well as steel partitions for concrete mangers. Manger partitions are

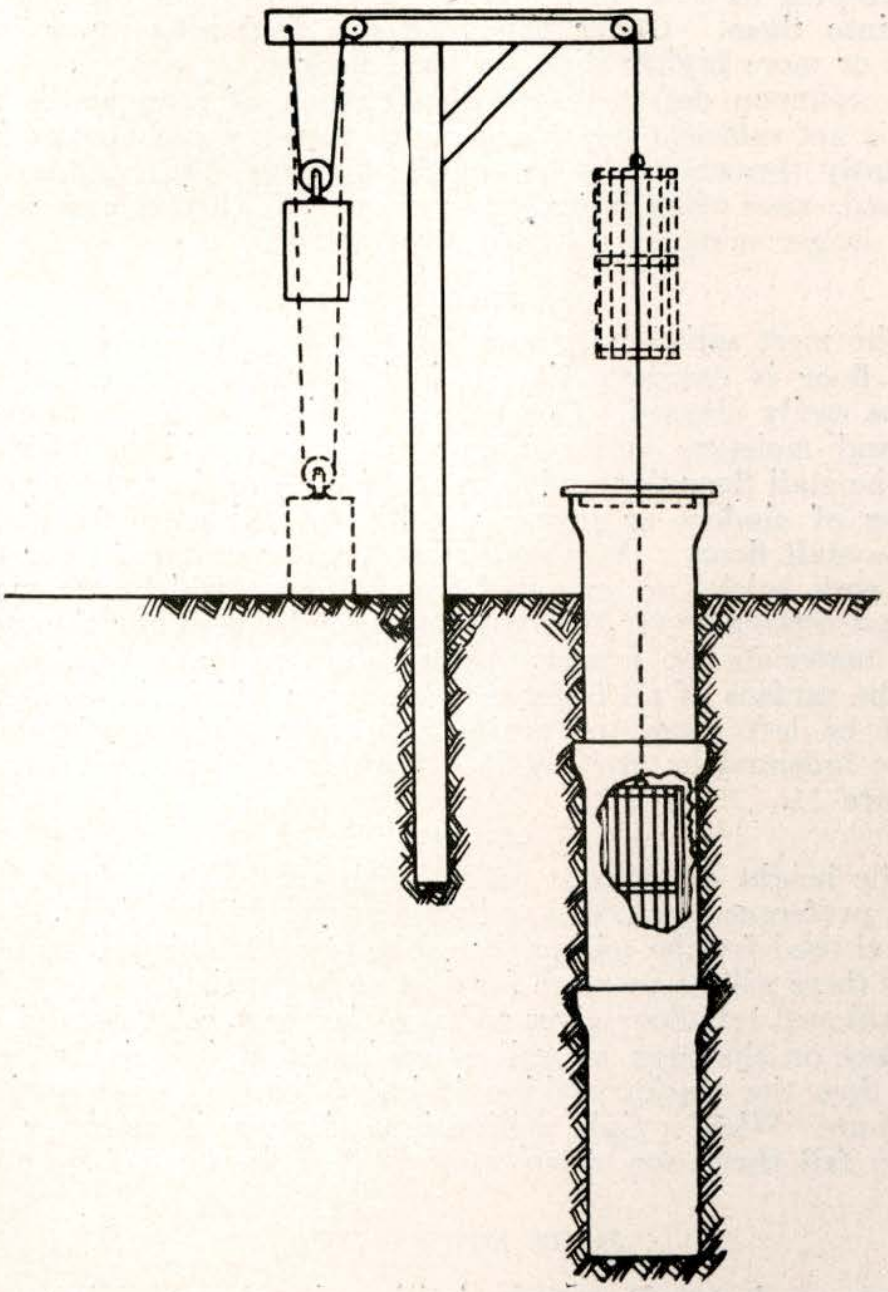


FIG. 18—PLAN FOR DRY WELL

An arrangement like this enables a small quantity of cream or articles of food to be held at a uniformly low temperature. The well is constructed by making an excavation and setting three large tiles in the ground.

almost a necessity if the best results from feeding are to be secured. Litter carriers are almost indispensable in barns not provided with a driveway thru the stable, and carts for carrying feed are likewise a necessity where feed must be transported for some distance in the barn. The individual water bowl attached to the stanchion is a more recent form of equipment than that just mentioned and is proving of value when so installed that there is no danger of the water freezing in the pipes.

FIG. 19—THE MILK HOUSE SHOWN IN FIGURE 1
Apparatus is provided for cooling and bottling milk, sterilizing milk bottles, etc.

Altho this system of watering the cows has several advantages, especially that of permitting the cows to remain indoors during stormy weather, such a system is far from being a necessity on most dairy farms. Some of the modern conveniences here discussed are illustrated in figure 10.

SUGGESTED PLANS

The various plans shown will, it is hoped, give the builder some new ideas as to how the dairy buildings can be made more sanitary, how they can be more conveniently arranged and how more economically built. It is not the intention to give

the impression that these suggestions represent the only desirable ones on dairy construction. They are simply intended to be suggestions of new and better ideas that may be incorporated in plans worked out to suit different conditions and locations. Hardly any two sites would permit exactly the same plan to be followed. (8 M)